ENGINEERING NEWS

Tribune Building, New York City.

GEO. H. FROST, PROPRIETOR.

SATURDAY, JULY 2, 1881.

WE learn from Mr. John G. Fonda, Civil Engineer, of Quincy, Ill., that the demand for engineers in that part of the country is greater than the supply. Mr. Fonda states that in a short time he will need the services of two or three good engineers on levee and railroad work, and further remarks that he is in receipt of a letter from a friend in Wisconsin who wants a locating engineer.

BROCKVILLE, June 28.—The excursion business on the St. Lawrence is very light this summer. The steamboat men attribute this to the recent London disaster.—*Globe.*

[We are not surprised now at the occurrence of the London disaster, and we are not surprised at the meagre excursion business after having "enjoyed" the "trip through the Thousand Islands and down the Rapids by daylight" in the Corinthian. American tourists should not forget that there is a new line just started from Lewiston to Montreal. The old tubs on the other side of the lake must be getting pretty shaky from age by this time, and ought to be given a wide berth.]

CONVENTION NOTES.

A more agreeable series of excursions than those recently taken by the American Society of Civil Engineers and their guests could hardly be planned on this continent. The alternation of railway and steamboat travel, the always interesting Falls of Niagara, and the St. Lawrence River scenery, the novelty of the cities visited, combined with the open-hearted, free-handed and charming hospitality everywhere tendered to the visitors, cannot fail to create a most agreeable reminiscence in the memoires of the recipients which will associate their late hosts in the Dominion with anything but frigid reserve or sectional prejudice.

Too much credit cannot be awarded to the local committees of the several cities visited for the generous liberality of their programmes, and the completeness with which they were carried out. At Montreal, especially, the committees, fearful that their city possessed but few interesting attractions, fairly outdid themselves in entertaining their guests, and we are sure that the receptions at Toronto, Montreal and Ottawa will never suffer from comparison with those that any American city can offer to the Society in the future.

One feature of these conventions is that usually too large a programme is planned, to be carried out successfully in the time alloted. The local committees arrange to do certain things on the theory that every minute will be diligently used, and that no "incidentals" will be brought forward. But in practice there are hours of lost time, and once in session the society is the recipient of numerous invitations to visit objects or places of interest, which, at times, tends to demoralize slightly the original programme. What the tribulations of local committees are only local committees know, and it would undoubtedly add to the comfort and easier working of such bodies in future if they would confer with their predecessors, and so learn where the most annoying failures in entertaining occurred, or the most gratification was gained. Local committees are usually made up of men who have hardly a minute to spare from daily business duties, and any suggestions that experience can give to lighten the added labor and save their time while wrestling with the problem of how to cram the most entertainment in the shortest possible time, will, no doubt, be acceptable to the future martyrs.

Referring to lost time, we must especially note the great lack of promptness in opening the sessions for reading papers. Appointing a meeting for one hour and commencing the business of that meeting an hour later is not "business." Civil engineers, as a class, are noted for promptness of action; the daily occurring emergencies of their professional duties demand it and thus render it a habit; when, therefore, they see 9 a. m. on the programme they expect to be on hand at that hour. The Boston daily papers commented on the refreshing promptness with which the Engineers' Convention in that city was opened and the business to be transacted was conducted, and all who attended that delightful reunion cannot fail to regret the want of similar promptness in succeeding ones. It is a growing evil, but one which can easily be, and should be eliminated in the future.

After all, the reading of papers has come to take a very secondary place in the convention programmes, and it looks very much as if they might yet be read "by title" only. After that there will not be any more conventions, as parties will go off to amuse themselves, where, and as they see fit. The American Institute of Mining Engineers holds each year several just such meetings as the one lately held in Montreal. At these meetings papers of great value to the profession and to the whole public are announced to be read and *discussed;* and they *are* read and they are *discussed* at great length and with a most refreshing interest. Between sessions the society is given numerous excursions, and the usual amount of banqueting, etc. A long list of papers is annually announced for the Convention of Civil Engineers, but what the reading, and especially the *discussion*, amounts to every member can judge for himself.

Now, if we mistake not, the reading of papers is the very "backbone" of the Society's existence, which, if weakened, will endanger the whole body. Men like Principal Dawson, E. P. Hannaford and others, who for the first time met civil engineers in council, expected to hear some valuable papers read and *discussed*. When, therefore, papers like Mr. Ashbel Welch's, Mr. R. Hering's and Mr. Buck's are allowed to pass without scarcely a comment, time is consumed with Mr. Latimer's anti-metric vaporings, and hardly any other of the actual business for which the Convention met is seriously considered, how long will it be until busy engineers cease to give their time and labor to the preparation of papers which will be at once creditable to their abilities and to the standard of requirement of the Society. A "good time" can be had each year, but not at the expense of the vitality of the Society, and it is to be hoped that when the time for another convention arrives preparations for the intellectual recreation of such members as desire it may be well considered, and so well provided for that there will be no failure. A few papers of acknowledged merit, previously circulated in time to allow members to prepare for their ample discussion, is about all that is needed. If members will not take sufficient interest in the papers to prepare for their discussion, then they must be held responsible for the lack of interest and attendance that will inevitably follow.

The leading aim must be to draw the best engineering talent of the country together for a few days, to allow of mutual acquaintance and the interchange of professional experience. The older engineers, while enjoying the pleasures of the travel and sight-seeing yet have already gone through a great deal of that, and desire something more to compensate them for leaving home and accepting the great fatigue of the excursion, while the younger members of the profession are usually on the alert to make the acquaintance of the older men, of whom they have often heard, and to gain the benefit of their experience on some subjects in which they may be interested. We feel certain, therefore, and we think we but echo the prevailing sentiment among engineers, that the social or excursion feature must be subordinated to the legitimate business for which the meetings of the convention are projected.

But we deprecate the idea that we wish to lessen the "social" feature of the Society. It is a most charming element in its composition, and we wish to see it well and wisely fostered. Secretary Bogart, ably seconded by his charming and universally esteemed wife, has been instrumental in developing a feeling of acquaintanceship among the members of the Society, which, through the medium of these annual reunions, cannot fail to result in many permanent and valuable friendships which will last for life and brighten as they grow in years. But Secretary Bogart is mortal and cannot do everything. His added duties at conventions and for a long time previous are very onerous, and he has no assistance worth mentioning. In view of the importance of a proper carrying out of the social part of the Convention, and other similar meetings of the Society, a "committee on social entertainment" is sadly needed. Whatever the duties of such a committee would be is quite patent to every reader, after witnessing the lamentable failures of the Society during the recent trip. The committee should at once offer a medal for the encouragement of making after-dinner speeches by members of the Society.

We have thrown out a few remarks in the preceding paragraphs which, while they may not be altogether palatable, will yet draw attention to some points that deserve very serious attention, and which, we will confess, are but reflections from the minds of some of the most valuable members of the Society, and cannot be allowed to go unheeded. We think there will be but one verdict regarding the Convention—that as an excursion it was a great success, but as a meeting of engineers for mutual improvement it was not up to the standard of former years.

ADDITIONAL LIST OF MEMBERS AND VISITORS AT MONTREAL.

In addition to the names already published, the following were registered at Montreal during the Convention: Cassimir Constable, Constable, N. Y.; C. L. Strobel, Keystone Bridge Co., Pittsburgh, Pa.; Thos. Doane, President Boston Society Civil Engineers, and Mrs. Doane, Boston; E. D. Leavitt and Mrs. Leavitt, Cambridge, Mass.; Sanford Fleming, C.E., Ottawa, Ont.; Wilson Crosby, C.E., N. Y. City; George H. Norman and son, Boston, Mass.; E. S. Chesbrough and Mrs. Chesbrough, Chicago, Ill.; Gen. Theo. C. Ellis, Hartford, Conn.; S. C. Ellis, City Surveyor's office, Boston, Mass.; Jos. P. Richards, Architect, Cambridge, Mass.; Chas. E. Fowler, City Engineer, New Haven, Conn.; C. L. Crandall, Mrs. E. Gross, Pittsburgh, Pa.; McK. Swift, W. E. Wisner and Mrs. Wisner, E. W. Bowditch, Boston, Mass.; Frank C. Whitney, City Surveyor's office, Boston; W. S. Barbour, City Engineer, Cambridge, Mass.; Fred. Brooks, C. E., Boston, Mass.; Chas. D. Elliott, Somerville, Mass.; J. J. R. Croes, C. E., New York city; Geo. A. Kimball, City Engineer, Somerville, Mass.; S. G. Artingstall, Assistant City Engineer, Chicago, Ill.; S. C. Pierson, Meriden, Conn.; F. Collingwood, New York and Brooklyn Bridge; Avery Merriweather, Memphis, Tenn.; M. L. Merriweather, Memphis, Tenn.; A. Dempster, Pittsburgh, Pa.

AMONG the many pleasing souvenirs of the conventions of the past four years the Programme takes a conspicuous place. Characteristic of Boston, the Programme, and other printed matter, was

first introduced there, and the example then set has since been followed at increasing expense of time, brains and money by the local committees. As in the whole art of entertaining, the Canadians have excelled in the Programm presented to the Convention this year. It consists of a handsome little volume of eighteen pages of reading, and nine beautiful photographic illustrations of Canadian scenery and engineering work. There are several pages of blank paper for memoranda, and the whole is bound in thick cardboard, the outside of which is also illustrated. Of the contents the first four pages are devoted to the programme proper of proceedings for each day, and which has already been published; on page 5 is given a list of illustrations which are as follows: Steamer Running the Rapids of the St. Lawrence; Victoria Bridge; Port of Montreal, Summer, showing the magnificent Docks and the Shipping; the same, in Winter, Showing the Ice piled on top of the Dock Walls; Ice Railway; Lock in Lachine Canal; Parliament Buildings, Ottawa; Timber Slide; Canadian Winter and Summer Scenery; all being beautifully executed photographs. The City of Montreal is described in two pages, the Victoria Bridge occupies two, Canadian water-ways two; canals of Canada two, dredging ship canal below Montreal two, Canadian railways and the area of Canada two; thus comprising within a small space some very valuable statistics of the Dominion, which must always render the little volume not only a pleasing souvenir of a delightful visit, but a reference book for use when occasion demands. The plates were selected and inserted in the programme with a view to covering some portion of each day's proceedings, and in that respect are most *apropos*. We are not sure as to who is entitled to the credit of this handsome and comprehensive little volume, but suspect that to Mr. P. A. Peterson a large share is due.

On reaching Ottawa on the 16th inst, a pretty little volume of eighteen pages was also distributed. It contained the programme of the day, the names of the Reception Committee, and then short descriptions of the city, Rideau Canal, Parliament buildings, Rideau Hall, Suspension Bridge over the Chaudière, city public buildings, sewerage, streets, water-works, water-power, Ottawa River and valley, the lumber trade and the minerals of the region, the whole bound in handsomely-illustrated covers of thick paper. We do not know who was the compiler of the work, but to the Committee is due great credit for their intelligent and acceptable method of giving their guests so much really valuable information about the capital city of the Dominion and its commerce.

PERSONAL.

Mr. Lawrence Bradford, for a number of years connected with public works in Boston, has accepted a position on the Mexican Central Railroad.

Mr. Fred. Brooks, of Boston, sailed for Mexico last Thursday. He has accepted a position on the Mexican Central Railroad, with headquarters in the City of Mexico.

Mr. H. D. Bush, formerly of the R. F. Hawkins Iron Works, of Springfield, Mass., has accepted a position as Assistant to Consulting Engineer of the Mass. Central Railroad. His headquarters are at Gardner, Mass.

T. N. Boutelle, Engineer for the Ft. Dodge (Ia.) Water-works (advertised elsewhere in this journal this week), is also preparing plans for the proposed enlargement of the Marshalltown (Ia.) Water-works, comprising new filter, pumping-engine and boilers of two and a half millions capacity, enlargement of buildings, pipe-extension, etc.

THE NEW YORK AND BROOKLYN BRIDGE.

(*Continued from page 233.*)

From a paper presented by Mr. Francis Collingwood, before the American Society of Civil Engineers, Nov. 1, 1876, we take the following extracts in regard to the

TOWERS:

The figures referring to the towers will be given chiefly in connection with the Brooklyn tower, and important differences only will be noted. The principal dimensions of these structures are as follows:

BROOKLYN TOWER.

	Heights.
Bottom of foundation below mean high tide.	44 ft. 6 in.
Base of stone masonry	20 " 0 "
Depth of water in immediate front of tower.	20 to 16 " 0 "
Height of roadway above mean high tide	119 " 3 "
" " springing of arches above high tide	198 " 0 "
" " " " " roadway	79 " 3 "
" " ridge of roof stone above mean high tide	271 " 6 "
Height of ridge of roof stone above bottom of foundation	316 " 0 "

NEW YORK TOWER.

Bottom of foundation below mean high tide.	78 " 0 "
Base of stone masonry below mean high tide	46 " 6 "
Depth of water at immediate front of tower.	34 " 0 "
Bottom of foundation to ridge of roof	349 " 6 "

In addition to all, there will be a balustrade around the towers on the cornice at the roadway and also at the edge of the roof slopes. This will increase the height to 276 ft. above tide.

AREAS OR HORIZONTAL SECTIONS.

At bottom of foundation (that is, bottom edge of caisson):

	Square feet.
Brooklyn tower is 102 × 168 ft.	= 17,136
New York tower is 102 × 172 ft.	= 17,544

At top of timber, the extreme measurements of the base of the masonry are: for

	Square feet.
Brooklyn tower, 151 × 49 ft., with a solid section,	= 8,542
New York tower, 77 × 157 ft., with a solid section,	= 9,115

At high water surface, the extreme measurements are:

	Square feet.
Brooklyn tower, 57 × 141 ft., with a solid section,	= 5,172
New York tower, 59 × 141 ft., with a solid section,	= 5,068
First 10 feet above high water of Brooklyn tower, 56 × 140 ft., with a solid section	= 4,983
New York tower, 59 × 140 ft., with a solid section	= 5,172
Brooklyn tower, about 39 ft. between 1st and 2d sloping offsets, 53⅛ × 137½ ft.	= 4,605
Brooklyn tower, about 38 ft. of same between 2d offset and cornice, 51 × 135 ft.	= 4,100
Brooklyn tower, upper member of cornice at roadway	= 4,932
At the base of the three shafts above the roadway, extreme measurements of Brooklyn tower, 45 × 131 ft., solid section of same (united)	= 2,297
At the springing of the arches, extreme measurements of same, 42⅛ × 128¼ ft. solid section (united)	= 1,932
At base of upper cornice, extreme measurements of same, 40 × 126 ft., with solid section	= 2,940
Top members of upper cornice, extreme measurements, 49 ft. 10⅛ in. × 135 ft. 10⅛ in., with a solid section	= 4,343

Above high water, the New York tower differs from the other only by an increase of three feet of thickness in the direction of the axis of the bridge.

QUANTITIES OF MASONRY.

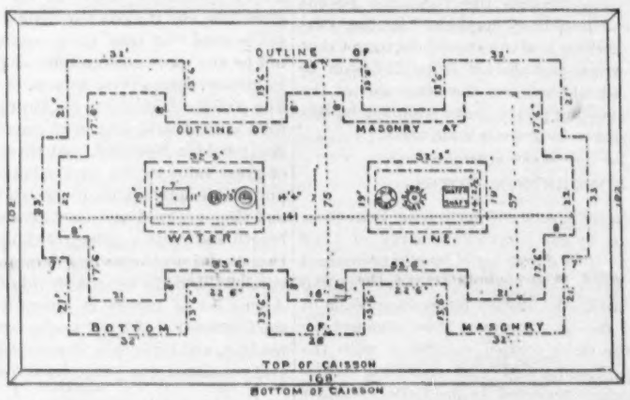
Brooklyn Tower.	Cubic yards.
From base of masonry to 2 ft. 4 in. above tide	6,144
" 2 ft. 4 in. above tide to roadway	19,250
" roadway to springing	6,033
" springing to top of tower	6,787
Total stone-work, excluding balustrades	38,214
Concrete in well holes, caisson chambers, on top of timbers, and between timbers	5,669
Timber and iron in Brooklyn caisson	5,253
Total cubical contents	49,136
New York Tower.	
From base of masonry to 3 ft. 7 in. above tide.	13,383
" thence to roadway	19,820
" roadway to springing	6,329
" springing to top of tower	7,413
Total masonry, excluding balustrades	46,945

The timber and concrete in the New York tower are about one-third more in quantity than in the Brooklyn tower. The amount has not (Sept. 1, 1876) been made up.

WEIGHTS.

Taking, per cubic foot, the granite masonry at 153 pounds, the concrete at 120 pounds, and the timber which contained iron and concrete, at 70 pounds, we get:

Brooklyn Tower.	Net Tons.
Total weight of stone masonry	78,931
" " concrete	9,184
" " timber, etc. (Sept. 1, 1876.)	4,964
Total	93,079



PRESSURES.

From the foregoing we get, for the Brooklyn tower:

	Tons per sq. ft.
Pressure at bottom of foundation, about	5½
" at base of masonry (per square foot of bed) about	9¼
" at high tide (per square foot of bed) about	13
" at base of central shaft above roadway, final (pressure) about	26

The latter is the greatest pressure at any point in the tower masonry, being about 361 pounds per square inch, and it includes the pressure resulting from the two central cables. At the bottom of the foundation of the New York tower the pressure is about 6¾ tons per square foot of area, and at the base of the masonry, about 10½ tons per square foot of bed. The pressure at the bases of the masonry will be increased about 8 per cent. by the weight of the superstructure and load.

DESCRIPTION OF TOWER MASONRY.

The general form of the tower masonry is shown in plan by the following figure. It consists of three buttressed shafts, joined together so far as the roadway by four connecting walls. At the course next the timber in the Brooklyn tower, these walls are 17 ft. thick; this thickness diminishes by offsets, until at high water and above it is 10½ ft. only.

Below high water, the two well holes thus formed are filled with concrete, and from high water to the roadway they are left open. Water in considerable quantities collected in them during construction.

Similar well holes or spaces were left from 2

feet above the arches to within 4½ feet of the top of the tower, but each of them is divided by an interior connecting wall (parallel to the others), thus making four spaces of 4 × 33 feet section and 25 feet high.

The only other space in the masonry is a small vertical opening in one of the wide shafts, 2 feet 5 inches × 3 feet, starting just above the springing of the arch and connecting with one of the well holes above. By means of an iron ladder in these openings, and a trap through the roof courses, permanent access can be had to the roof.

"Each arch has a span of 33 feet 9 inches. The arches are pointed and formed by the intersection of two arcs of circles described from centers in the springing plane, with radii of 45 feet 9¼ inches. The extrados has a radius of 48 feet 2 inches; with centers in the springing plane, so placed as to give a thickness of arch of 5 feet at the springing and of 4 feet at the point. The points of the arches are 114 feet 4 inches above the roadway.

"The changes which have been noted in the dimensions of the horizontal sections are made by sloping offsets in the buttresses, each of 7 feet 6 inches rise. Two of these are below and two above the roadway, and they connect the several vertical sections mentioned.

"Through each of the spaces spanned by the arches there will be carried one track for cars propelled by steam, and two tracks for vehicles drawn by horses. In addition there will be a foot track, which will be central in position and abut against the central shaft, passing around it both ways by tracks raised high enough to clear the cars; these tracks will be reached by flights of steps on each side of the shaft. This makes in all 7 tracks on the roadway—4 for horses, 2 for steam cars and 1 for foot-way.

"Leaving the subject of dimensions, the next thing in order is the character of the masonry. Throughout the work the specifications for stone have required, among other conditions, that the beds of all stones should be rough axed (or pointed), so as to allow of ¼-inch bed joints; and that the stone should be cut true to the rise. All vertical face joints from 4 feet below tide are ½ inch; below this, only good quarry faces were required; this gave joints of 4 to 12 inches, and closer ones could be secured for the face by selecting the stone. In dimension backing, the vertical joints were to be from 1 to 6 inches in width, and in all common backing quarry faces were allowed.

"Except where a face stone abutted against dimension backing, the rear face was left rough. Headers were allowed to be wider at the rear than the face, provided they were jointed back sufficiently for the adjacent stretchers. All face stone was paid for according to the dimensions on the plan, deficiencies on each stone being charged for at contract price, and excess allowed for as backing. The rule was finally adopted, and is now a part of every specification, that all stones of irregular shape (such as arch stones, cornice stones, etc.), shall be paid for, according to strict net measurement of their cubical contents; no constructive measurement being allowed. All bidders were notified to make their bids on this basis. The rises of the courses have been fixed in every case—the contractor bidding on specific rises. To accommodate the quarries, however, this has been varied between the limits of 20 and 30 inches; few being less than 27 inches, and the greater number being of 24 inches rise. The lengths of stretchers were fixed at from 6 to 15 feet, according to position, and the widths at from 3 to 5 feet. For ordinary stretchers, the contractor was allowed to vary in width within moderate limits where it did not affect stability or plan.

"Headers were made from 3 to 6 feet in width, the most common being from 3 to 4 feet, and none were allowed less than 6 feet long. The face stones ranged in cubical contents from 1⅓ to 5 cubic yards each (the face key stones measuring 5⅓ yards each). The backing will average 1⅓ cubic yards per piece in limestone and 1⅓ cubic yards in granite.

"All but the cornice and offset stones from high water to the roadway have a rock face of about 4 inches projection, and the arrises are pitched to a line. The corners of the buttresses have a vertical chisel draft of 1½ inches width. The arrises of all the offset stones have the same draft, and the face between is pointed down to a ½-inch projection. To heighten the contrast and produce the effect of horizontal bands, the granite in the offsets is of much lighter color than the rest of the stone. The faces of all the cornice stones are of six cut work (except on the sloping offsets as before described). Above the roadway, the face stones of the buttresses have the rock face projection reduced to about 3 inches; and a chisel draft is carried around the face of every stone. The pilasters facing the roadways are finished like the offset stones; and the intrados of the arches are smooth-pointed. The outer arch stones have a draft 3 inches wide, cut on the curved edge of the face and 2 inches wide on the other face edges; thus making a raised panel of 1½ inches height, which is rough pointed between the drafts.

"The voussoirs have a uniform thickness (length of curve on intrados) of 2 ft. 3 in. This gives a constantly diminishing thickness of the spandrel courses. The buttress and spandrel courses were, however, made to correspond in rise to the top of the thirteenth arch-course (this having a rise on the spandrel of 23¾ inches). The eighteenth spandrel course had a rise of only 18¼ in., and from the thirteenth to the eighteenth, the spandrel and buttress courses were unconformable. The bond was obtained by cutting down each and interlocking at the intersections, as best served to secure strong work. The study for this purpose was done by means of a model. The reason for not using thinner buttress courses and thus avoiding the necessity for such a construction, was, that the courses were too thin for the sizes of stone required by the regular bond in the buttresses.

"The general rule of the bond throughout the work is two stretchers to one header."

(TO BE CONTINUED.)

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 243.)

XXVII.—KANSAS CITY.

Kansas City, partly in Missouri and partly in Kansas, is in lat. 39° 5′ N., long 94° 36′ W., on the right bank of the Missouri River, just below the mouth of the Kansas River. The western part of the city, an area of about 2 square miles, is on the level river "bottom." Back of this a hill rises abruptly, and the eastern part of the city is a succession of ridges and hollows, varying in elevation from 75 to 260 ft. On the south, this hill slopes gradually to O. K. Creek (a branch of Turkey Creek), which forms the natural sewer of the southern part of the city, and discharges into the Kansas River two miles above its mouth.

The Kansas River is about 500 miles long and drains some 50,000 square miles between the Platte and Arkansas rivers. Settled about 1850, the population of the city in 1873 was about 40,000, when water-works were built by a private corporation, under an agreement with the city by which in consideration of the company's furnishing a sufficient supply for domestic purposes, and also a certain stipulated supply for fire purposes directly from the hydrants, when demanded, the city guaranteed the company the sum of $56,000 per year over and above stipulated operating expenses. The company on their part, agreed to have at all times the ability to throw in any part of the city twelve 1-in. streams 100 ft. high, or eight 1¼-in. streams 125 ft. high, or four 1½-in. streams 150 ft. high, 50 ft. of hose being used in each instance. While the first of these tests has been frequently made in the most difficult parts of the city, it has not been deemed prudent to risk attempting the others on some of the highest ground where the mains are single, merely for the sake of display. At all except these highest points, however, the capacity of the works to accomplish all that is demanded has been proved.

After some years of disagreement as to the compensation to be paid by the city, the original conditions were changed, and the city now pays a fixed hydrant rental.

Water is taken from the Kansas River near the mouth of Turkey Creek. A coffer dam was built in the river 50 ft. from the shore, the silt and mud excavated to sand bottom, on which was laid a platform of timber, under the centre of which was a cross trench of heavy timber, calked to prevent admission of ground water. A crib was built on the platform, in three compartments, the outer ones filled with gravel and the middle one open, to receive water filtered through the gravel, and conduct it to the cross trench, from which a 24-in. cast-iron pipe, 1,350 ft. long, conveyed it into a well. This pipe is a syphon, and enters the well 16 ft. above low-water mark, and is then turned down to a foot from the bottom of the well, which is 7 ft. below low water. A vacuum is maintained by an air-pump attached to the pumping-engine, and the syphon works satisfactorily.

The well was constructed by sinking a wrought-iron cylinder 14 ft. in diameter and 18 ft. high. The material inside was excavated, the bottom covered with 2½ ft. of concrete, and the caisson lined with stone masonry which was carried up 39 ft. to the engine floor.

The first pumping engines comprised one quadruplex Holly engine, with steam cylinders of 27-in. and pumps of 10 in. diameter and 30-in. stroke; one set of geared pumps driven by a condensing engine of 16-in. cylinder, with 27-in. stroke; and a set of low-lift pumps driven by gearing from the larger engine. To these have since been added a Holly quadruplex engine of nominal capacity of 5 million gallons, and a set of low-lift pumps of 8 million gallons nominal capacity.

The lower reservoir is of irregular shape and of two acres area, built in excavation and embankment near the river. The bottom is covered with concrete, underlaid with puddle, and the slopes are lined with brick on edge. This reservoir was so built as to provide for slow circulation of the water entering it and filtration through gravel before it was taken by the high-lift pumps. This reservoir, which has a capacity of 7 million gallons, has become too small, and a new one of 11 million gallons capacity is now in course of construction.

The force main, of 20 in. diameter, crossed Turkey Creek on a bridge composed of an arch of flanged pipe, from which another horizontal pipe was suspended. The line of pipe ascends the hill so steep that difficulty was experienced in getting the pipe into position, and in making them secure, in consequence of the treacherous clay and disintegrated rock encountered. The upper reservoir, which supplies the lower tower by gravity, is 252 ft. above the river, and at water surface is 330 by 380 ft., and 25 ft. deep. It is built in excavation and embankment, with concrete on the bottom and half way up the slopes, the upper portion being paved with limestone 12 to 20 in. thick. The object of this reservoir is stated by the engineer to be to furnish water to as much of the city as practicable in case of accident to the machinery, and by back pressure under the pumps to assist in

* Copyright 1881.

raising fire pressure without additional steam-power.

The distribution pipes are of cast iron, and are from 20-in. to 6-in. diameter. About 27 miles are now in use and 280 hydrants.

The works were built after the plans and under the superintendence of Galen W. Pearsons, C. E.

No publication has been made of the expenditures and revenue of the company owning the works. The superintendent is B. F. Jones.

XXVIII.—CAMBRIDGE.

Cambridge, Mass., is separated from the City of Boston by the Charles River. It was founded in 1630. In 1835, the population being about 20,000, a private company constructed water-works, taking their supply from Fresh Pond, a natural lake of 188 acres area, receiving the drainage of 569 acres. No streams flowed into the pond, which was partly within the city limits, until 1880, when the whole pond and its borders were transferred to the city. It discharges its surplus water through Alewife Brook.

The works were purchased by the city in 1865. In 1876, additional water was procured by building a conduit of wood and brick of 10.65 sq. ft. sectional area and 4,061 ft. long to Spy Pond, Little Pond and Wellington Brook. The waters of the two last named can only be used at certain seasons, on account of their pollution during most of the year. Fresh Pond is capable of supplying one and a half millons per day in dry weather. When more than two million gallons per day have been pumped from it, there has been a constant lowering of its surface without recovery. A filter gallery was also built in 1876, beyond Wellington Brook, which yielded 400,000 gallons per day for 63 days in 1880. The supply in 1880 was so deficient that a pump was placed at Fresh Pond with the intention of pumping into the supply conduit and lowering the pond below the conduit level, in case of a continuance of the dry season. Efforts were also made to obtain a supply from the Mystic Water-works of Boston, but those works were in the same condition of deficient supply for their own consumption at that time. A connection with the Boston pipes was made, however.

A supply conduit leads from the pond to the engine-house, where two Worthington engines were erected in 1855, each of 720,000 gallons per day capacity.

In 1868 a compound Worthington engine of five million gallons capacity was added, and in 1874 another of the same capacity was built and a new 48-in. supply conduit laid from the engine-house to the pond, 5 ft. below the old one, which was then removed.

The first force main was of 12-in. diameter. From the first large engine another was laid of 24-in. diameter, and in 1873 another of 30-in. diameter. The engines pump into a stand-pipe which is 122.7 ft. above tide marsh level, with an overflow at 120 ft.

The first reservoir is on the highest ground in the city, 2,300 ft. from the engine-house, and its water surface is 73.4 ft. above the pumps. It is 165 ft. square and 10 ft. deep. Its slopes are paved with stone. Another reservoir was built adjoining this in 1868.

The original reservoir leaked badly on being first filled, and extensive repairs were required before it became able to hold water. The retaining walls outside of the reservoir banks and the partition wall between the reservoirs have given much trouble. In 1878 a large amount of rebuilding and patching of walls, and pointing and grouting and paving, was necessary.

The distribution pipes originally laid were of wrought iron and cement. Cast-iron pipe are now used. A large proportion of the pipes are of small sizes.

On Dec. 1, 1880, there were 7,322 taps. Service pipes are now laid of galvanized iron with brass fittings and with shut-off at the sidewalk, and are laid from the main to the cellar of the house by employés of the Water Board. Five hundred and seventy-nine fire hydrants are in use, of which 240 are post and 339 flush hydrants. No new flush hydrants have been set since 1873, and many have been replaced by post hydrants. Meters have been in use since 1870. The present number is 156. The average daily consumption in 1880 was 2,423,220 gallons, and the population 52,740.

The works are controlled by a board composed of the Mayor, the President of the Common Council and five citizens. The superintendent from 1871 to 1877 was S. W. Dudley, and from 1877 to 1881, Hiram Nevons. The City Engineer, Mr. W. S. Barbour, superintends works of construction and advises the Board when called on.

The total cost of the works to Nov. 30, 1880, was $1,721,880.54. The revenue from water rents from April 28, 1865, when the city purchased the works, to Nov. 30, 1880, was $1,864,755.31.

The outstanding bonded indebtedness is $1,528,500 to provide for the payment of which there is a sinking-fund which now amounts to $414,568.48.

XXIX.—FALL RIVER.

Fall River, Massachusetts, is in lat. 41° 42′ 3″ N., long. 71° 9′ 37.5″ W., on the eastern side of Mount Hope Bay, an arm of Narragansett Bay. The city comprises 27.5 square miles.

The topography is irregular, the ground rising at some points to 260 ft. above tide level.

It was settled in 1659 and incorporated as a city in 1854. In 1870, the population being 26,766, the construction of water-works was decided upon, and a report made by W. J. McAlpine, C. E. In 1871 the works were begun, with George A. Briggs as chief and James P. Kirkwood as consulting engineer.

Water is taken from Watuppa Lake, 2 miles east of the city, which has an area of 5.5 square miles. Its storage capacity is ten thousand million gallons, and its surface is 128 ft. above tide water. Its mean daily discharge is estimated at 35 million gallons, and furnishes the water power which first attracted manufacturers to the town.

On the west shore of the lake 9,472 ft. from the main street of the city, the engine-house was built. To avoid heavy rock excavation on the steep banks, the building was placed 60 ft. from the shore in the lake. A coffer dam, composed of two rows of sheet piling 10 ft. apart, was built on the ice in winter and lowered to place. The material within the dam was excavated to rock in some places and in others the bottom was covered with 18 in. of concrete, on which the foundation walls were built.

From a gate-house 10 by 8 ft., its floor being 10 ft. below the lake surface, an arched conduit, 6 ft. wide and 4 ft. high, conducts the water to the engine-house, there dividing into 4 branches, one leading to each of 4 pump wells, whence it is pumped.

The first engine was a double horizontal condensing engine, with steam cylinders 28-in. and pumps 16-in. diameter and 42-in. stroke, coupled to a fly wheel shaft and arranged to work separately or together. Its nominal capacity is three million gallons per day, and at 24 strokes per minute can pump 4,750,000 gallons per day. The duty of this engine was not equal to the contract requirements, and after an arbitration $1,400 was deducted from the price named in the contract for its construction. It began pumping in January, 1874.

In 1875 a Worthington engine of five million gallons capacity was erected.

The engines pump into two stand-pipes; the low-service are 31.3 ft. high, its top being 280 ft. above tide level, and the high-service pipe 78 ft. high, with a weir opening 23 ft. below its top. A stone masonry tower 116 ft. high incloses the two stand-pipes.

The high-service distribution includes about one-quarter of the city.

Distribution pipes are of cast iron, coated with Dr. Smith's preparation.

Meters have been used from the beginning of the works, and in 1880 1,378 were in use, supplying about 62 per cent. of the consumers. The consumption is 1,263,923 gallons per day, and the population 49,006. The cost of the works to Jan. 1, 1880, was $1,432,906.11, and the receipts from water rents to the same date had been $293,264.96.

Five commissioners had charge of construction until 1874, when the works were placed in charge of the Watuppa Water Board, composed of three commissioners holding office for three years, one retiring each year.

George A. Briggs was chief engineer until December 31, 1874, after which date William Rotch was chief engineer and superintendent until December 31, 1880, when he was succeeded by William Carr, Jr.

XXX.—RICHMOND.

Richmond, Virginia, is in lat. 37° 32′ 17″ N., long. 77° 27′ 28″ W., on the north side of the James River, 151 miles from its mouth, at the head of tide water. There is a rapid descent in the river at this point which affords a head which is utilized for water power. The site of the city is on a cluster of hills.

Settled in 1609, its population in 1830 was 16,060, when water-works were built after the plans of Albert Stein, C. E., taking their supply from the river. A breast wheel 16 ft. diameter and 10 ft. wide drove a horizontal double-acting piston pump of 10-in. diameter and 72-in. stroke, which forced the water through 2,400 ft. of 8-in. pipe to a reservoir 166 ft. above the river. In 1834 another wheel and pump of the same size were added, and in 1854 two more pumps of 12-in. diameter and 72-in. stroke were put up. In 1874 a Jonval turbine of 9 ft. diameter, working under 10 ft. head, was erected, driving two horizontal double-acting pumps of 17-in. diameter and 72-in. stroke, which forces the water into a new reserv ir 203 ft. above the river. During the interruption of the supply from construction of these pumps, a Guild & Garrison steam pump of 12-in. diameter and 36-in. stroke was used to lift water from the James River and Kanawha Canal, 43 ft. above the water pumps. The steam pump is also used to aid in supplying water during freshets or low water.

In 1880 the water-power machinery was increased by a vertical turbine, after the plans of Charles A. Smith, C. E., which were selected from several competitive designs offered. The supply is still very defective, and for several weeks in the summer of 1880 about half the city was without water, and at one fire, at least, all that the firemen could do was to stand by and see the building burn. The water is highly charged with sediment, which settles very slowly. Samples left undisturbed for three months retain a decided color.

The first reservoir, built about 1831, was in two compartments, each 194 by 104 ft. and 10.7 ft. deep. A gravel filter bed was attached to each division, but they do not appear to have worked successfully. The reservoirs were of earth embankment, with a puddle core in the centre, and the slopes were lined with four inches of brick on edge laid diagonally on the slope. The bottom was paved with one course of brick flatwise, laid in lime mortar.

In 1844 the embankments were raised 6 ft., and the water surface made 256 by 382 ft. at 166 ft. above the pumps. In 1876 there were reported 6 ft. of mud in the bottom, which could not be removed by drainage. The influent and effluent pipes pass through the banks, with no gate houses.

The available capacity is 8 million gallons. The new reservoir, built 1874-5 is of earth embankment and has two divisions, each 416 by 426 ft. at water surface and 20 ft. deep, and containing 20 million gallons. It is provided with a masonry influent and effluent chambers, communicating with either division at will, and has a settling space below the low-water draught line, with arrangements for draining of the sediment. The slopes are 2 to 1 and lined with one course of brick on edge laid in cement mortar. The bottom is covered with six inches of concrete.

Distribution pipes are of cast iron. Uncoated pipes have lasted well for 40 years. There is a great proportion of small pipe in use. About 60 miles are laid. Meters are not used. There are about 6,200 taps.

The original works cost $95,000. The total cost to 1880 has been, including maintenance, about $2,500,000. The annual expenses are about $30,000.

A committee of the City Council manages the works, through a superintendent, the city engineer having charge of works of construction. The city engineer is W. E. Cutshaw and the superintendent H. C. Richmond.

(TO BE CONTINUED.)

SOUTH AMERICAN ENGINEERING NEWS.

A telegram from Pernambuco announces the opening of tenders for the construction of a railway from Timbaúba to Goyana. Only three proposals had been received, as follows: Messrs. Wilson Sons & Co., requiring an interest guarantee of 7 per cent. per annum for thirty years on the sum of 40,000$ per kilometer; Sr. Costa Carvalho, requiring a similar guarantee for twenty-five years on 50,000$ per kilometer; and Messrs. Snell, Read & Bowen, requiring only the privileges conceded by law, and dispensing with the guarantee.

The representative of Siemeur, Kermos & Co. has applied to the municipality proposing to illuminate the Plaza Victoria, and some of the principal streets in Buenos Ayres, with electric light. The lamps would have to occupy places now filled with gas lamps, and the electric machine in the *patio* of the Cablido. The strength of the light is represented as 350 stearine candles, or 17½ gas burners, per lamp. At present it is proposed to put up twelve lamps.

The club of engineering lately founded at Rio Janeiro proposes to have some of the best works on engineering subjects translated into Portuguese.

The club has sketched out an immense programme, being no less than to furnish statistical and other information of the whole industrial world of Brazil. They intend also to publish an annual, which will certainly be valuable if the "plan" is carried out.

CORRESPONDENCE.

CHAUDIERE BRIDGE.

TORONTO, June 27, 1881.

EDITOR ENGINEERING NEWS:

It is stated in your narrative of the Chaudière Bridge, at Ottawa—Vol. VIII., No. 24—that the floor system is of a design not in use before the construction of that bridge. This is not correct.

The floor system mentioned is a design adopted by the Grand Trunk Railway in the year 1877.

T. D. H.

ONE HUNDRED FEET TAPE.

ERIE, Pa., June 24, 1881.

EDITOR ENGINEERING NEWS:

M. J. Wells asks for a strong tape one hundred feet long. I have an excellent one, made by Young & Sons, Philadelphia. It has often been passed over by a wagon, and is not yet broken. The one I have is only graduated to feet. For a pocket tape divided to hundredths, I prefer a Paine to a Chesterman, as they are much less easily broken.

W. W. BRIGDEN, City Engineer.

MANKATO, Minn., June 21, 1881.

EDITOR ENGINEERING NEWS:

Say to your correspondent, M. J. Wells, that he will find the chain tape manufactured by Young & Sons, Philadelphia, what he wants. I have been using one the past year, and consider it the best measuring line I ever saw. It is light, accurate and durable.

M. B. HAYNES.

AVERAGE HAUL.

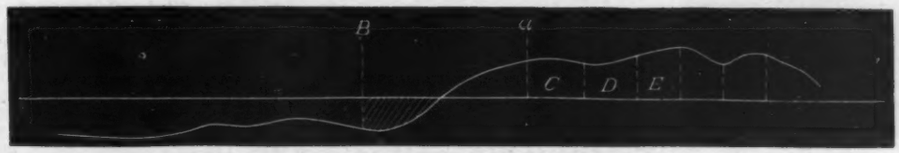
CLEVELAND, O., June 22, 1881.

EDITOR ENGINEERING NEWS:

The inclosed figure may be of some assistance to "Resident Engineer:"

It becomes necessary to determine the excess when work has been carried on until material taken from the cut at *A* and deposited in bank at *B* must be moved more than 300 feet.

Let *C D E*, etc., represent the number of cubic yards in the succeeding stations, which are here assumed to be of equal length.



Observing that the center of the mass *C* is approximately half a station, and that of the mass *D* one and a half stations from the point *A*, use the simple form,

$$\frac{\frac{1}{2}C + 1\frac{1}{2}D + 2\frac{1}{2}E + etc.}{C + D + E + etc.}$$

to determine the distance (*m*) from the point *A* to the center of gravity of the excess *C D E*.

In like manner find the distance (*n*) from the point *B* to the center of gravity of the same number of yards when placed in an embankment, and *m* + *n* will equal distance for which "extra haul" on the excess should be computed. Sub-contractors will doubtless call "Resident Engineer's" attention to the "fact" (?) that it will be much cheaper for the company to permit them to waste and borrow than to fix such distances that (*m* + *n*) 1c. will become nearly equal to the contract price for earthwork.

D.

AVERAGE HAUL.

[If "Resident Engineer," who had an inquiry under the above title in ENGINEERING NEWS of June 18, will send his address to Bates & Auchincloss, No. 209 Church street, Philadelphia, he will receive pamphlets bearing upon the subject.—ED. ENG. NEWS.]

FORMULAS FOR TURNOUTS.

KOKOMO, Colorado, June 15, 1881.

EDITOR ENGINEERING NEWS:

Since there seems to be some interest manifested upon the subject of frog distances, through the later issues of ENGINEERING NEWS, I desire space in your columns to present some formulas for their generality, as being formulas, not only for the determination of frog distances under the usual conditions of turnout from tangent or curve, with a curved lead rail, but for determining those distances where a portion of the lead rail, next to the frog, is desired to be straight. I make use of letters in referring to all lines and quantities, in the accompanying diagrams, for the sake of generality; such letters as those representing gauge, throw

FIG 1.

and slide rail would, upon any one railroad, have a constant value, thereby rendering these formulas much more terse than they seem with operations merely indicated.

Referring to the diagrams,

s = loose part of slide rail.
t = throw.
y = sum of the dotted semi-tangents to curved part of lead rail.
a = straight portion of lead rail.
g = gauge of track.
b = No. of frog.
and x = distance between tangent rail through point of throw, and the intersection, *I*, of the semi-tangents, *y*.
D O = distance between tangent to point of throw, and tangent to point of frog measured on a line passing through *I*, being on a straight main track, as in fig. (1), coincident and equal with *F E*, which represents the gauge (*g*) measured through *I*.

In fig. 1,

$$x = \frac{ty}{s} + t \text{ and } g - x = \frac{a}{b} + \frac{y}{2b}$$

or,

$$x = g - \frac{a}{b} - \frac{y}{2b}$$

If we eliminate x by comparison of these two equations we have

$$\frac{ty}{s} + t = g - \frac{a}{b} - \frac{y}{2b}$$

which, when reduced, becomes

$$y = \frac{bs(g-t) - as}{bt + \frac{s}{2}} \quad (1).$$

Suppose now we want to use a No. 8 frog, our gauge is 3 ft., throw 5 in., the unspiked portion of

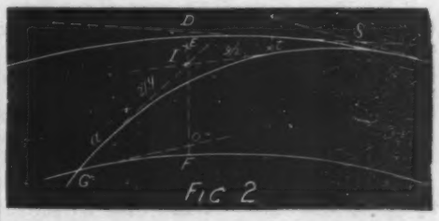


FIG 2

slide rail is 20 ft., and we wish to have 8 ft. of straight lead for drives to straighten out on as they approach the frog; substituting these values in equation (1), we have

$$y = \frac{253.44}{13.33} = 19;$$

that is, we find our lead should be 27 ft. long, 8 ft. of it being straight.

By reference to figures 2 and 3 it will be seen that

our $D\,O$ has changed position and magnitude, but is yet as in fig. 1, the distance between the tangent, through point of throw and tangent, through point of frog, measured through I.

In fig. 2 $D\,O = g + D\,E - F\,O$, and in fig. 3 $D\,O = g + F\,O - D\,E$, $F\,O$ being the greater quantity, as is evident in both figures.

Practically (but not exactly)

$$D\,E = \frac{y}{4\,R} \times \frac{y}{2} = \frac{y^2}{8\,R},$$

R being radius of curve of main track, and practically

$$F\,O = \frac{2\,a + y}{4\,R} \times \frac{2\,a + y}{2} = \frac{4\,a^2 + 4\,a\,y + y^2}{8\,R},$$

hence,

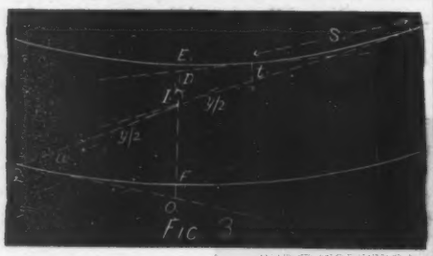
$$D\,E - F\,O = -\left(\frac{a^2 + a\,y}{2\,R}\right),$$

and

$$F\,O - D\,E = +\left(\frac{a^2 + a\,y}{2\,R}\right).$$

Substituting these values of $D\,O$ in equation (1), we have for fig. 2:

$$y = \frac{b\,s\left\{g - t - \left(\frac{a^2 - a\,y}{2\,R}\right)\right\} - s\,a}{b\,t + \frac{s}{2}}$$



and for fig. 3

$$y = \frac{b\,s\left\{g - t + \left(\frac{a^2 + a\,y}{2\,R}\right)\right\} - s\,a,}{b\,t + \frac{s}{2}}$$

these equations when reduced become (2):

$$y = \frac{2\,R\,(g\,b - t\,b - a) - b\,a^2}{R\left\{\left(\frac{2\,b\,t + s}{s}\right) - b\,a,\right.}$$

and

$$(3)\quad y = \frac{2\,R\,(g\,b - t\,b - a) + b\,a^2}{R\left(\frac{2\,b\,t + s}{s}\right) \times b\,a}$$

by writing $\pm$ instead of the two last signs in these equations we may have one general equation, the plus sign to be used in case of fig. 3, the minus sign in case of fig. 2: The conditions of lead rail, frog, throw, etc., assumed for fig. 1 gave us 19 feet for curved portion of lead rail; on a 20° curve, fig. 2, by the last equation will give us 17.4 feet, and fig. 3 21.2 feet.

If in equation (2) or (3) we make R = infinity, and the $\pm$ terms = 0, as would be the case on straight track, we have equation (1) back again. Also if in each of the equations (1), (2) or (3), we make $a = o$ (that is assume no part of the lead rail to be straight) they each reduce to

$$y = \frac{b\,s\,(g - t)}{b\,t + \frac{s}{2}}$$

thus demonstrating the fact that when no part of the lead rail is assumed to be straight, its length will not vary whether the turnout be from a tangent or any curve whatever (other conditions of course being the same).

This last equation is the same as that given by E. A. Rudiger in NEWS of January 15. I hope that when looked upon in the light of their general application and their entire freedom from trigonometrical functions these formulas will be regarded as practically useful.

In finding the values of $D\,E$ and $F\,O$, I have assumed,

$$a + \frac{y}{2} = G\,F, \text{ and } \frac{y}{2} = E\,t,$$

which is not exactly true, but so close an approximation that the error accruing in the final result in ordinary cases will not exceed one-half per cent., and in extreme cases two per cent.

The above figures suggest a ready means of finding the position of frog with the use of two tape lines, and without calculation. Fasten the end of a tape line at s (midway along the loose part of slide rail, on the intersection of the small semi-tangents), and stretch it from that point through the inner extremity of the throw: let this line remain in that position, while two assistants stretch another one diagonally across the track, intersecting first line, and in such position that the angle it makes with the frog rail will be the frog angle, then let them slide it back and forth along the track until the distance from the intersection of the tapes to point of throw equals the distance from this intersection to where the siding tape line is held on frog rail, this last is the point of frog, when no straight lead is required; if some straight lead is required, this last distance should exceed the other by the amount of straight lead.

S. E. REAUGH.

FILBERT STREET (PHILADELPHIA) EXTENSION OF THE PENNSYLVANIA RAILROAD.

The Pennsylvania Railroad Company, recognizing the necessity of having its principal passenger station for the city of Philadelphia in a more central location than that afforded by the building at Thirty-second and Market streets, and also requiring improved facilities for transportation of freight from its depot at Sixteenth and Market streets, by direct steam connection, took active steps in the early part of the year 1879 toward the construction of what is termed the "Filbert Street Extension," and destined shortly to be thrown open for traffic.

This line branches off from the terminal system known as the West Philadelphia yard by two passenger tracks and one freight track. The former leave the old passenger tracks near Powelton avenue, and, diverging to the left by a 4-degree curve compounded at each end with a curve of 30 minutes, cross over the tracks connecting with the tunnel under Market street, and a lower-grade system of freight tracks, by a substantial iron-plate girder bridge of five spans, having stone abutments and intermediate piers of wrought-iron columns on stone foundations. The very heavy askew of this bridge, varying from 63 to 72 degrees from a vertical to the abutments, and the fact of the tracks being also on a curve, increased the difficulties and expense of construction considerably. The span on the square between abutments is only 72 ft. 6 in., whereas on the line of the tracks it is about 190 ft.

Leaving this bridge the line, continuing on a curve, is carried by an embankment, on a descending grade of five-tenths to the hundred, to Thirtieth street, which it crosses by a wrought-iron, triangular truss, deck bridge, at about 33 ft. above street grade. This bridge has an askew of nearly 12 degrees right, and is about 72 ft. clear span. The curve of the line terminates at about 440 ft. beyond this point, and there strikes a tangent in the course of Filbert street. The freight line, which is a single track, leaves the lower-grade system of tracks in West Philadelphia yard, previously mentioned as running under and south of the new passenger tracks, and crossing Thirtieth street by a similar bridge, but at a lower grade and at right angles to the street, finds itself also in the course of Filbert street. Coming into proximity with the passenger line at the terminal point of its curve, all three tracks now run parallel in the direction of Filbert street across the flats of the west bank and over the Schuylkill river. The freight track, having an ascending grade of one foot per hundred east from Thirtieth street, reaches the level of the passenger tracks at the river bridge, whence all continue the same level grade. Arriving at a point about 100 ft. west of Twenty-first street, on the east side of the river, the line curves right with a three-degree curve on to the south side of Filbert street for a length of about 400 ft., reaching the west end of the "Filbert street passenger yard" at the east side of Shock street.

The approaches to the river bridge from Thirtieth street on the west and Schock street on the east are carried by plate-girder deck bridges, supported by wrought-iron columns, the webs and flanges of the girders being of steel, steel riveted, and the balance of the work of wrought iron. There are 14 spans on the west approach and 30 on the east. These spans vary, those on the west side from 44 ft. to 55 ft. 3 in., center to center of columns, while for those on the east there is a span of about 21 ft. over Shock street, one of 50 ft. 4 in. over Twenty-first street, 60 ft. over Twenty-second street, 50 ft. over Twenty-third street, and the balance vary from 43 ft. 6 in. to 54 ft. 9 in., center to center of columns, the measurements given being on the square, although where curves occur the girders are actually longer, being askew. On the west side of the river the stone foundations for the columns carrying the girders are built on timber piles cut off at low-water mark. On the east side they are founded on compact gravel at a depth of from 12 to 26 ft. below the grade of the street. The columns on the east side are located on the curbs of the street, leaving the carriage way clear between, and the height of track above street-grade varies from 22 to 36½ ft. On the west approach the height from ground to track varies from 25½ to 33 ft.

The Schuylkill River is crossed by a wrought-iron deck bridge of three spans, at an elevation of 40 feet above city datum, or 42½ feet above ordinary high tide. The substructure, which consists of two abutment piers and two piers, is constructed of eastern granite. The western abutment pier, measuring 87 feet in length by 7 feet in width on the bridge seat, and 22 feet high, with a batter of one-half inch to the foot, is constructed upon a timber foundation resting on piles driven to the rock. The western pier has a crib foundation consisting of squared timber filled with stone and concrete, and resting on a rock bed 31 ft. below low water. At the eastern pier, the nature of the rock surface, dipping at a considerable angle, rendered it advisable to use a coffer dam in putting in this foundation, which is laid in masonry from the bottom, 67 ft. below the grade of the track, the pier being 49 ft. in height. The two piers are of the same size at bridge seat as the abutment piers, but in addition have cut-waters at the ends, both up and down stream. The eastern abutment pier is of the same dimensions as the western one, and is founded upon the rock, being located at the foot of Filbert street, inside of the wharf line. It has an arch opening through it 17 ft. span, to allow a passage way to the river.

The superstructure of the river bridge is on the double intersection triangular truss system, extensively used on the Pennsylvania Railroad, the braces sloping at an angle of 45 degrees, or nearly so, and intermediate vertical stiffening members being introduced from the points of intersection of the braces to the upper chord.

The general dimensions of superstructure are as follows:

Distance center to center of piers, western span	144 ft.
Distance center to center of piers, two eastern spans	160 ft.
Number of trusses each span	4
Width center to center of truss	10 ft.
Depth of truss, center to center of chord pins	14 ft. 9⅛ in.
Number of principal panels in each truss	10
Number of sub panels in each truss	20
Length of panel in upper chord, western span	14 ft. 2 in.
Length of panel in lower chord, western span	14 ft. 1⅛ in.
Length of panel in upper chord, two eastern spans	15 ft. 8 in.
Length of panel in lower chord, two eastern spans	15 ft. 7⅛ in.
Length of western span, center to center end pins, upper chord	141 ft. 8 in.
Length of each eastern span, center to center end pins, upper chord	156 ft. 8 in.
Total length of bridge, end to end of superstructure	464 ft. 9 in.

The upper chord is formed of plates and angles connected by rivets, the lower portion of this chord being open, and the flanges stiffened by light bracing across. Particular care has been taken in designing details to make all surfaces, both exterior and interior, easily accessible to painting and to form no close boxes. The lower chord consists of bars or links running in full panel lengths. The braces subjected to compression are formed of channels and plates properly stiffened with bracing between. Braces subjected to tension only are formed of links. Lateral struts are used in sub-panel lengths in the upper chords with lateral ties throughout. The lateral system is used in full panel lengths in lower chord. Inclined diagonal bracing is used in full panels and sub panels between the outer pairs of trusses only. Pin connections are employed throughout. One end of each truss is placed on rollers to allow for expansion and contraction.

The "Filbert street passenger yard," on the

south side of Filbert street, from the east side of Shock street to the west side of Sixteenth street, a distance of 2,042 feet, by 106 feet in width, on property purchased by the company, and affording accommodation for nine tracks, is carried by a series of segmental brick arches, consisting of 8 spans of 24 feet, 48 spans of 26 feet, and 4 spans over crossing streets of 50 feet in the clear, the arches all having a rise of 7 feet from springing to crown. The street arches have abutment piers of 18 feet in thickness at springing, and the smaller arches have piers of 4 feet 4 inches in thickness. The work is of brick construction throughout, laid on stone foundations varying from 6 to 20 feet in depth. The arches, after completion, were covered on top with a layer of asphalt 1¼ inches in thickness, and intended to prevent the leakage of water through them. Foot-walks four feet in width, protected by an iron railing on the outer edge, and intended for the use of employés engaged on duty in the passenger yard, extend along Filbert and Jones street fronts, being supported by brackets built into the face of the walls. A wrought-iron turn-table, 60 feet in diameter, is located on the north side of the yard for turning engines of local trains, and just east of the turn-table, at the east side of Seventeenth street, an opening is left in one of the arches for an hydraulic elevator, to accommodate the United States mail and also express and transfer baggage.

Sixteenth street, at the east end of the "Filbert street passenger yard," is spanned by a plate-girder deck bridge, the girders being arched between with brick to deaden the sound of passing trains to city travel below. This bridge gives access by ten tracks into the second floor of a building on the block of ground contained between Market and Filbert, Fifteenth and Sixteenth streets, where was formerly located one of the freight stations of the company.

The old building has been partially removed, remodeled, and added to, giving virtually a new iron and brick structure of two stories in height, and intended for freight and passenger business. The area of ground covered by this building is 135 ft. north and south by 396 ft. 8 in. east and west. The first floor is used exclusively for freight, and passage ways for wagons on Market and Filbert streets, the former 41 ft. and the latter 35 ft. 8 in. in width. Large doors open along the whole front on these two streets, those on Market street averaging 19 to 29 ft. in width each, and those on Filbert street being 15 ft. each. The balance of the area between these driveways is occupied by a platform 230x390 ft. and elevated about four feet above the ground level. The average height of this story above the platform is about 15 ft.

The second floor is carried by wrought-iron columns and plate girders, presenting to the eye below quite a forest of pillars. It is divided into two parts; that next to Market street, for a width of 135 feet, is used for freight purposes, having four tracks arranged in pairs, with platforms 4 feet high and 20 feet wide between each pair. The capacity of these tracks is about 35 cars. Sixteen hydraulic elevators, with capacity of five tons each, and platforms eight feet square, communicate with first floor. The balance of second floor next to Filbert street, having a width of 172 feet, is used for passenger-train house. It is provided with eight tracks, which are arranged one next to each outside line, and the balance in pairs. There are four platforms, one between each pair of tracks, 24 feet in width and elevated about 14 inches above the rail.

The building is covered with an iron truss roof supported by wrought-iron columns, that over the freight portion consisting of three spans, two of which are of the ordinary French triangular system, placed at a height of 24 feet to the square above second floor. The third span is a flat lean-to roof, nearly at a level with second floor, there being no second floor under this part. The passenger portion has a handsome iron pointed arch roof of two spans, 85 feet each, the construction being quite architectural in appearance, and decorated with ornamental iron work. The interior of the wall is of red and buff ornamental brick and terra cotta, with sill course and skirting of blue marble. The passenger roofs and two spans of the freight roof have ridge ventilation and skylights of ⅜-inch hammered glass, extra lights and ventilation being placed on the passenger roofs half way down the pitch on each side. This building contains the boilers for supply of steam to pumps of hydraulic elevators and for heating of passenger station.

They are located on Sixteenth street near Market, and have a chimney 6 ft. in diameter and 100 ft. high. The building at this point is emphasized with ornamental gable, and probably shows the only architectural feature in the whole exterior, the rigid requirements of adaptability to purpose and use of old material excluding it elsewhere.

An ornamental covered plate-girder bridge carries the eight passenger tracks over Fifteenth street to the passenger station, which is situated on the lot of ground bounded on the west, north and east by Fifteenth, Filbert and Merrick streets. The sides of this bridge are of cast-iron and glass, on a wrought-iron frame-work, and the roof is an extension of the train house roof previously described.

The area of ground covered by the passenger station is 122 feet 10 inches on Filbert street by 193 feet 5 inches on Merrick street. Situated at a prominent point in the center of the city, where the location, so far as any one can judge, is permanent, an opportunity has been afforded and embraced for a solid structure, with good architectural display. The exterior presents handsome façades on Merrick and Filbert streets, the former being the principal one, designed in a free treatment of early Gothic. The first story is of Fox Island granite, in large blocks with rock face, the subordinate details of windows and other openings being finely cut and molded. This gives a general effect of great strength and solidity, and at the same time sufficient refinement in detail to avoid any appearance of roughness or gloominess. Above the first story the face walls are of red pressed and molded brick and terra cotta. The latter has been used quite extensively, and the nature of the material has called forth an exuberance of decoration which, while almost a necessity, has added great richness to the effect. The design throughout has been made steadily subordinate to the constructive necessities of a substantial and permanent building, thoroughly adapted to the purposes for which it is intended.

The front on Fifteenth street has been left much more simple in character, while the south wall, being a party wall and concealed by any future building that may be put up, is perfectly plain. The height from ground to eaves is about 75 feet, and top of roof 93 feet. A clock tower, 37 by 21 feet and 176 feet high, is located at the corner of Filbert and Merrick streets. Its situation, with Filbert street in front, doubled in width by the retirement of the Public Buildings, gives it a position where it shows to great advantage from either street, adding character and dignity to the general effect. On the Merrick street front, in the second story, are five medallion heads, in terra cotta, representing the five races of mankind, and typical of the cosmopolitan tendencies of the Pennsylvania Railroad.

Entering the building on the first floor by the Merrick street front, it will be noticed that it is divided into three parts. The center, for a width of 80 feet, is occupied by a carriage drive-way and two foot walks, extending through from Merrick to Fifteenth street and divided by the columns supporting the second floor into four divisions. The part on the right of this is appropriated to departing passengers, and has an inclosed lobby or entrance room, with separate offices for through and local tickets, a double stairway and double elevator leading to the second floor, and a departing baggage room on the rear next to Fifteenth street.

The part on the left of the driveway contains the stairway and exit for arriving passengers, and has on the rear next to Fifteenth street the arriving baggage room. Lifts are provided for both arriving and departing baggage, running to the second floor and cellar. On Filbert street is a private stairway leading to offices in the upper part of the building. The area reserved for departing baggage amounts to about 2,160 square feet, and for arriving baggage 2,700 square feet. The entrance stairway has two side flights, of 11 feet each, running into a central flight of 16 feet. The exit stairway is 32 feet wide. The entrance lobby has an area of about 3,200 square feet, and the exit lobby at foot of stairs about 1,000 square feet.

The passenger elevators occupy a space of 256 sq. ft. The passenger purchasing his ticket and passing up the entrance stairway, or ascending the elevator, finds himself on the second floor in a general waiting-room, 51 × 80 ft. and 45 ft. high, with large doors opening toward the trains on the west, ladies' waiting-room on the east or Merrick street front, and restaurant on the south. The ladies' room is 29 × 80 ft. and 30 ft. high, and has on the north a ladies' private room, and on the south a dining-room, the latter being 29 × 74 ft. and 30 ft. high. The restaurant, which also connects with the dining-room, is 23 × 51 ft. and 16 ft. high. A barber shop in the rear of the restaurant furnishes conveniences to those who require them, and has bath-rooms attached in the half story or entresol above. Over the restaurant in the same half story is a private dining-room. A stairway and dumb-waiters adjacent to dining-room and restaurant connect both with a kitchen and pantries on the third floor. All necessary lavatories, etc., are provided for passengers in convenient locations.

On the west of the main waiting-room is the train lobby, 33 ft. wide, and extending the whole length of the Fifteenth street front, directly across the end of the prolongation of the train-house over the Fifteenth street bridge. The northern half of this communicates with departing trains by gates to the various platforms; and this is the first point where the passenger is obliged to show his ticket, the first and second floors of the building being otherwise free of access to the public. The southern half of the train lobby, communicating with the exit stair hall, is appropriated to arriving passengers, and also has gates to the various arrival platforms of train-house.

The private stairway from the Filbert street entrance, which is fire-proof, extends from the cellar to the fourth floor. There is also an elevator in connection with this stairway. The cellars are available as additional storage room for unclaimed baggage and other purposes.

The third floor contains a kitchen 33 × 51 feet, and store-room 34 × 16 feet, with hydraulic elevator extending to cellar, and dumb-waiters previously mentioned to dining-room and restaurant. The balance of this floor is divided up into offices, fronting on the interior around an open gallery over the main waiting-room. The fourth floor is occupied entirely by offices. The area for offices on both these floors amounts to about 31,000 square feet.

The first and second floors of the building are constructed in brick arches between rolled iron beams, the second floor being supported by wrought plate girders, with ornamental cast-iron columns and brackets. The brackets on the wall lines spring from blue marble corbels.

The upper floors have timber joists carried by wrought-iron plate girders. In regard to interior finish, decoration is applied actually to the construction, to which it is kept subordinate, and is not mere superficial ornamentation.

The interior faces of walls in all public rooms on first story, and in stair halls and lobbies of second story, are of enameled or pressed and molded bricks of selected colors, built in and forming an integral part of the actual walls, being bonded by visible heading courses at regular intervals. Blue marble is used in basis and caps of columns, skirting, dado, caps, arches, jambs, window sills and other carven and molded work. The shafts of columns are of polished red Bay of Fundy granite. The floors are laid with marble tile. The stairways are of solid marble with ornamental iron railings.

The wood finish for first and second stories is of oak, ash and cherry, the waiting-rooms and dining-rooms being wainscoated to a height of 10 feet and other public rooms 6 feet. The offices in the upper floor are simply finished in yellow pine, in plain and substantial manner, adapted to their use.

The glazing of first and second stories is of plate glass, and cathedral glass is used in transoms and for other decorative purposes.

Great care has been taken in designing this building to make it suitable in every way for its purposes, not only in regard to the actual business of the station but also for the comfort of the public, and particular attention may be called to the directness of communication from part to part, there being no intricate passages or places where one can lose himself, or be uncertain as to the proper direction to take.

The iron superstructure of the river bridge, the iron work of approaches, the iron bridges over streets, and the passenger and freight stations and train-house have been designed by Mr. Joseph M. Wilson, engineer bridges and buildings Pennsylvania Railroad.

The masonry work, including foundations, abutments, and piers of river bridge, and brick arcade on Filbert street, have been designed by Mr. W. H. Brown, engineer of maintenance of way, who has also had charge of the erection and general execution of the work on the ground.

We hope to be able, in the future, to give further details of some of the special structures of this great work.—*Railway World.*

It is very probable that a contract for the Madison (Wis.) Water-works will soon be let, as the sentiment in favor of such action is growing stronger daily. Mr. Billings is to make a new proposition.

OHIO SURVEYS.

The following extract is from an able paper read at the meeting of Ohio surveyors, held in Columbus, in January last, by Mr. F. J. Sager, County Surveyor of Union County:

"Among the first and most important lines ever run in Ohio were those occasioned by the Treaty of Greenville. The most important feature of this boundary to surveyors was that it departed from natural boundaries and involved the running of lines. The one which crosses what is now Central Ohio, was nearly 145 miles in length. From personal observations on this line, and from the testimony of others, it is evident that they were governed in their course by the magnetic needle, which was almost constantly affected by local attraction, and continually threw them out of line, either to the right or left, while the needle at any place on this line would uniformly indicate about 80° east of north, showing apparently a straight line. This line, when mentioned in the laws and records of Ohio, or the United States, is considered and treated as a straight line, but when examined independent of the magnetic needle it proves to be a very crooked one. Nevertheless all adjacent government surveys were based upon it, and there is hardly a county within twenty miles of it but what depends upon it for its location. There is at this time a litigation between two counties near by which must use this line as a base for the settlement of their boundary. Yet it is a fact with this line, and also with many more such lines of equal importance in the State of Ohio, that the marks and evidence of their location have been allowed to become almost entirely obliterated. Upon a recent and careful examination of about twenty miles of this line there could be found but three trees which bore the original marks of the surveyor's ax and the Indian's tomahawk. Upon all our old land lines in the whole State of Ohio the old landmarks are becoming rapidly extinct, and when they are gone there will have perished the only reliable evidence of our lines and corners, for to attempt their exact location by the prevailing methods of courses and distances will lead only to continual litigations. It is but proper to say here that because of the short length of the term of office of County Surveyor, together with the failure of politics or law to recognize ability in surveyors, and the indifference of legislators, there has been no general or systematic effort made to perpetuate for public use our landmarks.

"Our institutions demand the preservation and perpetuation of the monuments of our land lines and boundaries of the past and present for the use of the future. The object of our profession should be to revise and practice the most simple and accurate means to accomplish this end.

"The existing laws relating to this subject, at least the existing customs and practices extant in Ohio today, have surely a downward tendency. With all respect to those who are careful and honest in their work as surveyors, land lines, monuments and records are becoming more obscure and complicated. At least this is so in the irregularly surveyed districts, such as the 'Virginia Military Lands;' because, first, a large part of the resurveys and subdivisions of the present are made by incompetent men. There being no distinction between ignorance and intelligence, the man who will work for a few cents less per day is the man who does the business. There are men in this State who call themselves surveyors, doing a business in surveying, who cannot make a calculation of the contents of a survey by latitude and departure. Second. All the work of these men, good or bad, is in a manner lost, there being no provisions by which a public record of their work can be kept for public benefit in the future. Even of the surveys made by the county surveyors there is not one in ten that he is required by law to record or in which there is in any way provided that the same may be recorded at public expense for public benefit. Third. The manner in which many instruments of conveyance are made. Incompetent men are allowed to compose descriptions for instruments of conveying lands which are daily recorded in the county records without even being examined by a competent expert. You will find a surprisingly large per cent. of these instruments imperfect, and in some of them the descriptions are as unintelligible as the hieroglyphics on Cleopatra's needle.

"Men have become enemies for years over a disputed line involving, perhaps, not over one-fourth of an acre of land, not worth more than forty dollars per acre, who would carelessly receive an imperfect deed, jeopardizing the title to their entire lands. A fourth cause: The decay and removal of land-marks. The old 'monarchs of the forests,' under the persecutions of the woodman's ax, of frequent storms, fires and other causes, are fast passing away. Upon them we find the only marks of the Government surveys, made by the first surveyors. As these trees become extinct, so do our landmarks. For these and many other reasons, a work well begun by the United States Government is suffered to go for naught. We are gradually drifting away from those evidences, such as we now have, into uncertainty, into endless litigations, quarrels and disputes. Men who should be neighbors and friends are made enemies. A large per cent. of the cases upon the dockets of our courts arise directly or indirectly from disagreements in regard to land lines and corners.

"But a few days since a case was related in the public press, the result of which was a long and aggravated law suit. The case was carried from one court to another, and back, until the costs reached four thousand dollars. One man twice had his barns burned. The other party is now awaiting his trial for the crime of arson. The end will no doubt be the penitentiary and ruin. All this about a disputed land line, involving a few feet of ground, the marks of which had become lost.

"There is another lamentable evil which occurs more frequently in the Virginia Military Lands, which constitute a large portion of the State. It was a custom of the first surveyors in this district to add or throw in a per cent. in their surveys, sometimes five and sometimes ten per cent. It nearly always happens that a line as given in the original patent is considerably short of its true length when correctly measured, to what is known to be the correct corner. It was not long until great advantage was taken in this way by dishonest men. They knew that by the court rulings, if the corner was unquestionably proven, it would govern without regard to course, distance or quantity. These surveys being miscellaneously located, without regard to any base line, but in every variety of irregular shapes, it was not possible for the government to detect any errors as to quantity, or any disposition to be dishonest.

"Because of this condition of affairs, there are many instances where the government was cheated out of large tracts of land.

"When the original owners sold their lands in small lots, they soon had the amount charged to them on the Auditor's books transferred away, and were still the owners of large tracts of land. These cases were so numerous that in many counties to-day large amounts of property are untaxed. There is one county in this State in which the commissioners refused, in 1879, a proposal to have the entire county actually surveyed, for one-half the tax, for ten years, on lands which the surveyors agreed to find, that was not on the Auditor's tax duplicate, and on which to-day neither the State or that county receive any taxes.

"It may be a matter of surprise to some that it is the policy of some surveyors at the present time to hide or cover up cases of this kind, and make their descriptions to call for more or less number of acres. For the reason that if he reports he immediately loses his business, for land owners employ men who look after their interests, and attend to their own business, and there is no law to protect the county surveyor in his position or business, if he reports them. Our legislatures have spent immense sums of money for the Geological Palentological Survey of Ohio (to which, understand, we offer no objections), but all this time has been chiefly for the direct benefit of miners and a small portion of merchants and mechanics. In these districts, to which this survey has been the least benefit, has been contributed the greater part of the taxes to pay the expenses of it, in which they cannot be interested as much as they are in the system of surveying their lands and perpetuating their lines and corners. Yet the only attention the legislatures have given this class of surveying for years is to cut down one-fifth the paltry fees of their surveyors, and thereby drive from the profession many men of ability, and weigh down and fetter the intelligence which still heroically labors to remove the existing evils."

THE INSTITUTION OF CIVIL ENGINEERS.

To-night, on the fifty-third anniversary of the founding of the Institution of Civil Engineers, the President, Mr. Abernethy, will hold his annual conversazione at the South Kensington Museum, and with this pleasant social gathering there will be brought to a conclusion a session which has been unusually successful, not only as regards the character and variety of the papers read, but also as regards the discussions, the weekly attendances, and the number of additions made to the list of members. Altogether fourteen papers were read during the past session, the titles being as follows: On "Machinery for Steel-Making by the Bessemer and Siemens Processes," by Mr. B. Walker; "New Zealand Railways," by Mr. T. P. Maxwell; "Ceylon Railways," by Mr. J. R. Mosse; "The Different Modes of Erecting Iron Bridges," by Mr. T. Seyrig; the inaugural address of the President, Mr. Abernethy; "Deep Winning of Coal in South Wales," by Messrs. Brown and Adams; "Portsmouth Dockyard Extension Works," by Mr. C. Colson; "Plant and Temporary Works Employed at the Portsmouth Dockyard Extension," by Mr. C. H. Meyer; "Weight and Limiting Dimensions of Girder Bridges," by Mr. M. am Ende; "Tide Gauge, Harmonic Analyzer, and Tide Predictor," by Sir W. Thomson; "Comparative Endurance of Iron and Steel exposed to Corrosive Influences," by Mr. D. Phillips; "The Actual Lateral Pressure of Earthwork," by Mr. B. Baker; "The Relative Value of Upland and Tidal Waters in Producing Scour," by Mr. W. R. Browne; "Torpedo Boats and Light Yachts for High Speed Steam Navigation," by Mr. J. I. Thornycroft, and "Production of Paraffin and Paraffin Oil," by Mr. R. H. Brunton. It will be seen from this list that nearly every branch of engineering was represented, while the majority of the papers dealt with subjects of special interest and of such a character as to evoke excellent discussions. It is in the facilities which it affords for the thorough discussion of the papers read that the Institution of Civil Engineers has one of its greatest advantages over kindred scientific societies. If a subject of importance is brought forward at the Institution ample opportunity is afforded for the expression of the opinions of the members and others upon it, and there is no hesitation in devoting two or more evenings to the discussion of one paper if the interest exhibited in it is such as to warrant that course. At the meetings of other societies we could name, where the reading of a number of papers is crowded into some two or three consecutive days' meetings, it is but rarely that the discussions are at all so full as they should be. We lately, too, in reviewing the last-published volume of the Transactions, commented upon the excellent plan which has been adopted of giving considerable space to written remarks upon the papers read; this is a feature which might be adopted with great advantage by other kindred societies. In speaking, however, of the success of the recent session of the Institution of Civil Engineers, and on the progress made by the Institution as a whole, it is only right that we should refer to the very important extent to which that progress is due to the labors of the Secretary, Mr. James Forrest. Mr. Forrest has now given the Institution twenty-five years of continuous service, while prior to that period he had served the Institution unofficially for seven years more; and it is worthy of record that during Mr. Forrest's secretaryship the names on the register of the Institution have increased from under 800 to 4,000, a fact which speaks for itself. With what skill, judgment, and energy the duties of Mr. Forrest have been performed is well known throughout the profession and deserves every recognition, and we can only express the hope that the Institution may very long continue to benefit by his ability and experience.—*Engineering, June* 8.

NOTES.

ELECTRIC POWER.

The electric tramway which Dr. Werner Siemens has constructed in Berlin, between the suburb of Lichtenfeld and the Cadettenhaus, is now regularly opened for passengers, and is giving great satisfaction. The rails are of the ordinary railway pattern, but the gauge is only 3 ft. 3 in. A single car is propelled by the current at an average speed of nine miles an hour, though this rate can be doubled if necessary. A similar line has been erected at the Crystal Palace, Sydenham, as an attraction for visitors, but it is probable that electric tramways will be practically introduced into this country before many years are past. Velocipedes are now so common that it is not surprising to find that electricity has been applied to their propulsion. M. Trouvé, the well known French electrician, recently drove an English tricycle through the streets of Paris by means of electricity in a Planté secondary battery and a pair of Duprez electric motors. The tricycle with its occupant and apparatus weighed 4 cwt., and went at the speed of an ordinary cab; but with some modification of the apparatus, M. Trouvé hopes to attain a rate of 12 or 15 miles an hour. The new secondary battery of M. Faure will also help his purpose, and we may anticipate that velocipedes driven by electric power will by and by prove useful to the invalided or weakly. In Paris, too, electricity has been applied to work an air compressor at the toy balloon factory of M. M. Chanchard et Cie, behind the Hotel du Louvre. The spare steam power of the engines has been utilized by two Gramme machines, one of which generates the current and the other transfers it into mechanical work. The energy thus transmitted is about a horse-power per minute.—*Engineering*.

THE PANAMA CANAL.

The official report from Panama, bearing the date of April 30, states that the work of surveying the district is approaching completion, and that the course of the canal is rapidly being settled. The points at which the actual work of excavation will be commenced are decided upon, and the construction of the necessary buildings at these points is proceeding. A saw-mill has been already erected at Colon, where a number of stores and warehouses are in progress. Nine wooden barracks have ere this been completed, and seventy more are ordered some from France and some from New Orleans. A large quantity of timber has been ordered, and some which was urgently required has been purchased at Panama. The fitting shops were being pushed forward, to be ready to fit up the excavators, locomotives and wagons, which are being constructed for the work. One of the Couvreux

excavators left Antwerp on April 23, and has no doubt arrived before this, while another was to follow without delay. The rolling stock is expected to be shipped about July 15. A list is given of material in process of construction, among which are: Four excavators, 10 tank engines, 400 contractors' wagons, 840 tons rails, 12 tons chairs, turn-tables, points, and crossings, bolts and spikes, etc., 4 steam dredgers, 6 steam sludge hoppers, 18 barges, one 40-ton steam pontoon, one 5-ton steam crane, one 2-ton traveling steam crane, a variety of miscellaneous plant, telegraph material, Morse instruments, telephones, and two steam launches, in sections. It is intended to utilize as much as possible the River Chagres for the transport of the plant. This river runs from Matachin, in the middle of the Isthmus, to the Bay of Colon, crossing the line of the canal several times. It has been discovered that there is a passage across the bar at its mouth, 16 ft. in depth; so that the shallows which were believed to render it useless as a means of transport are proved not to exist. The number of Europeans in the employment of the company who had left France for the Isthmus up to April 25 was 73. This number included a doctor, chiefs of the various departments of the service, fitters, smiths, carpenters, navvies, wheelwrights, storekeepers, a brickmaker, a butcher, miners, draughtsmen, etc.

SHIP CANAL, ISTHMUS OF CORINTH.

The project for piercing with a ship canal the historic Isthmus of Corinth did not originate with M. de Lesseps, as the early reports might lead one to suppose that it did; nor is it to be carried forward under his supervision. He has only promised his sympathy and such aid as he can spare from other enterprises in canals that now absorb his time and septuagenarian energy. The project is, however, French—and there would be something almost incongruous in it if it were not French. Gen. Turr, a geographer of reputation in Europe, has the scheme in charge, and, from the Greek Government, has received a concession to go on with it. Not only is the project not M. De Lessep's; it is in no considerable degree new or original, for such a work was contemplated, it is believed, long before the Christian era began, and was certainly revived afterward by a Roman emperor. At the period of her greatest prosperity Corinth realized only too deeply the inconvenience and positive loss which she suffered from the circumstances that obliged her to have one harbor for her gulf and another for the Ægean Sea. It appears not to be matter of positive record that the Corinthians ever determined to dig a canal; but that the desire to do so was often in their minds, and that the subject was considered, may fairly be inferred from the necessity for a canal and a work with similar purpose that they did actually do. What was known to them as the Diolcos was a polished roadway, so built across the isthmus that vessels could easily be hauled over from the Ægean to the Adriatic Sea. When Corinth had been restored after its first destruction, Nero caused the building of a canal to be undertaken, and to this day the ruins of the preliminary work done under him remain to view. He desired, it is said, to begin the work with his own hands, but a mutiny in the seven-hilled city prevented him from going away. For some cause, not further explained than in a mere suggestion of lack of money, the work was stopped at the threshold and never revived. Possibly there was trouble in piercing the rock, but this surely could not have been an insurmountable obstacle to an age which had just completed the Claudian aqueduct, and was centuries younger than the pyramids. It is believed that a canal through this isthmus will forward the commercial growth of Corinth as nothing else has done in nearly two thousand years.

ELECTRIC LIGHT ON RAILROADS.

Railroad men have recently been considering the feasibility of using the electric light for headlights to their engines and for the purpose of generally illuminating trains. The difficulty in the way seems to be that the jar of the locomotive and coaches is liable to cause uncertainty in the continuity of the light. But there is one method that does not appear yet to have been discussed to which this objection will not apply. That is, utilizing the existing telegraph poles and wires for the purpose of making a continuous illumination along the railroad tracks. There are 80 telegraph poles to the mile, and if on every other one of these were hung an electric lamp the entire track could be made as light as day. This would do away entirely with the need of the expensive and cumbrous headlights, and, to some extent, with the necessity for using oil lamps in the trains. It would also obviate all the dangers to railroad traffic that are now incident to the darkness. Accidents resulting from washouts, or fallen trees, or land slides, would be things of the past. Obstructions placed by malicious persons on the tracks would be seen at once, or, were the malefactors to take the precaution of cutting the wires before attempting to wreck the train, that would at once extinguish all the lights within the circuit and give warning to the train officers that danger was ahead. Moreover, suppose the case of a train dispatched on mistaken orders; as soon as the case was discovered, the operator at the battery could, by a simple movement of the hand, extinguish the lights, which would be a signal for the trains within his circuit to come to a stand and wait for orders. It may be urged against the suggestion that some of the lamps might get out of order, and remain so, unless a close and expensive system of supervision were maintained. This difficulty can be met with the further suggestion that, by a simple system of lettering and numbering the lamps, the engineers of passing trains could report to the next station what particular lamp or lamps might happen to be out of order. At any rate, the plan, which has been suggested by a practical railroad man of great experience, presents so many points of apparent advantage that it must be worth examination. To the public at large it would certainly give a greater feeling of security than is possible under the present system; and, if the economical questions connected with it can be satisfactorily adjusted, it would undoubtedly be considered a large step in advance.—*St. Louis Globe-Democrat.*

ELECTRIC CONDUCTIVITY AND STRESS.

The influence of mechanical stress on the electric and magnetic properties of metal wires has occupied the attention of several physicists of late. M. Gaiffe, for example, has demonstrated that the vibration of iron telegraph wires by the shocks of the wind is capable of generating feeble electric currents which may be heard in the telephone. The recent researches of Professor Hughes have thrown a great deal of fresh light on the subject, and clearly showed that M. Gaiffe's result is due to the magnetizing influence of the earth's magnetic field, and that wires running in an east and westerly direction that is, at right angles to the earth's lines of magnetic force, must of necessity be free from such telephonic perturbations. Steel wires, too, which have a strong coercitive force, will probably be less liable to generate these currents by the displacement of their magnetic molecules. The influence of tensile stress and vibration on the electric resistance of iron, steel, brass and copper wires has just been investigated by the Italian doctor De Marchi, who finds that, apart from the effect of diminished diameter, a pull upon a wire increases its specific resistance. At first, when the pull is very feeble, there seems to be a slight decrease of resistance, but as the pull is augmented, the opposite result ensues. Within certain limits the increase of resistance is generally proportional to the increase of tension, and beyond these limits the change proceeds by successive "leaps," evincing a momentary disturbance among the molecules of the wire. When the wires are set into vibration their resistance also varies, and when the vibration is sonorous the variation takes the form of a diminution of the resistance, especially if it is harmonic. On the other hand, when no sound is audible, the variation is in the direction of an increase of resistance. The specific resistance of copper, brass and lead wires has also been proved to increase very slightly under compression by the Russian Physicist M. Chwolson, of St. Petersburg. On subjecting the wires to a hydraulic pressure of 60 atmospheres between two steel plates he found the coefficient of increase per atmosphere of pressure to be for copper 0.0000013, for brass 0.000011, for lead 0.00011, or ten times as much as for brass, a result probably due to the greater softness of that metal. We may also mention that in a recent paper to the Royal Society, Mr. Herbert Tomlinson recounts experiments which prove that the torsional rigidity of copper and iron wires is temporarily changed by the passage of a powerful electric current.

CELLULOID.

The current number of *La Nature* contains a long and interesting description of the manufacture of celluloid, a combination of pyroxyline and camphor. The pyroxyline is obtained by treating cigarette paper with sulphuric and nitric acids. The paper is supplied in rolls 13 in. wide, and weighing about 50 lbs.; it is unrolled gradually and passed through a mixture of five parts of sulphuric acid of 66 deg. and two parts of nitric acid of 42 deg. Baume, kept at a temperature of 95 deg. Fahr. After about fifteen minutes saturation the paper is transformed into nitro-cellulose, and can be dissolved in a mixture of alcohol and ether. When it has reached this condition it is taken out of the bath and thoroughly washed in water; it is afterward placed in a paper engine and reduced to a homogeneous pulp, which has to be bleached with permanganate of potash, and afterward thoroughly washed a second time. Oxide of manganese has been formed during the process, and this is removed from the pulp by treatment with sulphurous acid, followed by a series of washings in water. It is then submitted to the action of centrifugal drying machines until it retains only 40 per cent. of water, when it is ready for conversion into celluloid. It has passed through a roller mill, at first alone, and then mixed with a suitable quantity of camphor, and coloring matter if the celluloid is to be opaque. After twelve passes through the mill, the mixture is placed in a hydraulic press within iron frames and between ten or twelve sheets of blotting-paper, which gradually absorb the moisture, but which have to be renewed from twelve to fifteen times. When dried the celluloid is in sheets about $\frac{1}{8}$ in. thick, and these are broktn up between bronze toothed rollers. The broken pieces are then soaked with from 25 to 35 per cent. of alcohol for twelve hours. The mixture is then passed through rollers heated to about 122°, and sheets .47 in. thick, and 31 in. by 24 in. are obtained; from 17 lbs. to 26 lbs. being treated at a time. These sheets are then placed in a hydraulic press in frames heated by the circulation of hot water. The remarkable material resulting from this long process has a density of 1.53. When cold its surface is smooth and highly polished; it receives readily any coloring matters, and can thus be made to imitate ivory, tortoise shell, etc. Subjected to a temperature of 176° it becomes soft, and can be molded into forms of the utmost delicacy, which harden when cold. If maintained at 266°, it decomposes, and gives off nitrous vapors, and at 383° the decomposition of the material becomes violent. If it be suddenly heated in the open air it catches fire and burns brilliantly, leaving but very little residue; it can be ignited easily by contact with a light. If heated to 356 deg. and struck with a hammer it explodes violently. Although it will be seen that celluloid is a comparatively unstable and even dangerous material, it is used to a very large extent, especially for ornaments and decorative purposes, as it can be made to imitate very closely amber, jade, shell, coral, ebony, turquois, etc., and the material can be molded to any desired form. It was first made in 1869 by I. S. & J. W. Hyatt, in Newark, New Jersey, but the principal factory for several years past has been at Stains, near Paris.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

A company has been established for the purpose of introducing water in Somerville, New Jersey.

The Holly Manufacturing Company of Lockport, N. Y., has within the last fortnight closed contracts with the city of Binghamton, N. Y., for a six-million gallon daily capacity Holly quadruplex compound condensing pumping engine, with the city of Rock Island, Ill., for a three-million gallon engine of the same kind, and with the town of Lake, Ill., for two of Gaskill's compound condensing vertical pumping engines of eight million gallon daily capacity. The duty guaranteed is 70,000,000 to 80,000,000 foot pounds.

LAWS OF NEW YORK.—[By Authority].

[Every law, unless a different time shall be prescribed therein, shall commence and take effect throughout the State, on and not before the twentieth day after the day of its final passage, as certified by the Secretary of State, Sec. 12, title 4, chap. 7, part 1, Revised Statutes.]

CHAP. 213.

An Act to amend chapter seven hundred and thirty-seven of the laws of eighteen hundred and seventy-three, entitled "An act in relation to the creation and formation of water-works companies in towns and villages of the State of New York."

Passed May 5, 1881, three-fifths being present:

The people of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1, Section two of chapter seven hundred and thirty-seven of the laws of eighteen hundred and seventy-three, entitled "An act in relation to the creation and formation of water-works companies in towns and villages of the State of New York," is herby amended so as to read as follows:

Section 2. Whenever any persons to the number of

seven or more, shall organize for the purpose of forming a water-works company to supply water to any of the towns or villages and the inhabitants thereof, in this State, they shall present to the town or village authorities an application setting forth the persons who propose to form said company, the proposed capital stock thereof, the proposed number and character of the shares of such capital stock and the sources from which water is intended to be supplied. Such application shall be signed by the persons who propose to form said company, and shall contain a request that the authorities of such town or village shall consider the application to supply such town or village of this State, or the inhabitants thereof, with pure and wholesome water. Said authorities shall, within thirty days of the presentation of said application, determine by a vote whether said application shall be granted; and the authorities of any town or village in this State are hereby authorized and empowered to make such determination, and when the same shall be made, to sign a certificate to that effect and immediately transmit the same to the persons making such application, or either of them. If such application is granted in whole, or in part, duplicate certificates of such determination shall be filed in the office of the clerk of said town or village, and in the office of the county clerk of the county in which the town or village granting such application shall be situated. The persons named in such application shall thereupon meet and organize as a water-works company under such corporate name as they may select. They shall file in the office of the Secretary of State a certificate of such organization. Said certificate shall recite the fact of such application and determination, and shall contain the name of the corporation, the names of the members of said corporation and their residences, the amount of capital stock, the location of the office of said company. Such certificate shall be subscribed by the persons by whom such application was made and sworn to by a majority of such persons. Upon the filing of said certificate said water-works company shall be known and deemed a body corporate, and shall be capable of suing and being sued by the corporate name which they shall have selected, in any of the courts of this State, and shall have the right to lay and maintain their pipes and hydrants for delivering and distributing water in any street, highway or public place of such town or village, for which consent shall have been given as heretofore provided. The capital stock of said company shall be paid in in the manner and within the time provided by the "Act to authorize the formation of corporations for manufacturing, mechanical, or chemical purposes," passed February seventeenth, eighteen hundred and forty-eight, and the several amendments thereto, and the stockholders of said companies shall be personally liable for the debts of said companies in the same manner and to the same extent as is provided by said act and the amendments thereto, but they shall not be liable for any debt secured by a mortgage. The authorities in this act authorized and referred to are as follows, to wit: For any incorporated village, the board of trustees thereof and the supervisor of the town; and for any town, the supervisor, justices of the peace, town clerk and highway commissioners thereof. And all acts to be done under this act by such authorities may be done by a majority of their number at a meeting duly called or held.

Section 2. Section five of said first named act is amended to read as follows:

Section 5. Said corporations are authorized and empowered to supply the authorities or inhabitants of any town or village, where they may have organized, with pure and wholesome water, at such rates and cost to consumers as they shall agree upon, and such town or village, by its said authorities, may contract with such company for the delivery by said company of water through hydrants or otherwise, for the extinguishment of fires and for sanitary or other public purposes, and the amount by such contract agreed to be paid shall be annually raised as a part of the expenses of such town, and any such corporation shall have the power to borrow money for the purpose of constructing its works and to issue bonds and mortgage its property and franchises to secure the payment of the same.

Section 3. This act shall take effect immediately.

State of New York, Office of the Secretary of State, ss: I have compared the preceding with the original law on file in this office, and do hereby certify that the same is a correct transcript therefrom and of the whole of said original law.

JOSEPH B. CARR, Secretary of State.

STREETS, DRAINAGE, ETC.

The city of Chicago has advertised for bids for the engines for pumping sewage at Bridgeport, to be opened July 8.

The Commissioner of Public Works, of this city, will open bids on July 12 for building and altering sewers and paving streets. For further particulars see *City Record* of June 30.

BRIDGES.

Dundee, Kane county, Ill., has voted to borrow from $7,000 to $10,000 to rebuild the bridge at that place, which was destroyed by the flood a few weeks ago.

The contract for the stone work of the Trenton, Ohio, bridge was awarded on the 27th, to McKeon & Flenner for $16,350. The total cost of the structure will be about $30,000.

Owing to the continued illness of Mr. Frederick H. Smith, the Baltimore office of the Baltimore Bridge Company will be closed for the present. All communications should be addressed to C. Shaler Smith, Bridge Entrance, St. Louis, Mo.

In one week from this time the Indiana & Kentucky Bridge Company will advertise for bids for the construction of their bridge at Sand Island. The plans and specifications are now on file in the office of the company, and will soon be ready for inspection. The preliminary arrangements, such as making soundings, etc., have already been made. It is estimated that the bridge will not cost more than $1,800,000 at the furthest, and probably not more than $1,500,000.

Certain features of the new Tay bridge that shall supplant the one which went down with such frightful loss of life appear to have been exactly fixed upon. Its total length will be 10,000 ft., or about two miles, and calculations are made for double the wind pressure which the strongest gale will ever bring to bear upon the bolts. The wind pressure is placed at 21 lbs. per square foot, and allowance is made for 56 lbs. Each pier will be entirely independent of an old one, and will be placed in an opposite position. It is intended that there shall be a parapet of wrought iron, as a precaution in case a car should leave the rails.

The Des Moines River bridge, on the line of the St. Louis, Des Moines & Northern Railway, was let on the 25th inst. to Raymond & Campbell, of Council Bluffs, Iowa, for $36,500. It will be two combination deck spans, with grade line 95 ft. above the water. It will be 366 ft. long and will be supported on iron trestle piers with iron cylinder filled with concrete for foundation. Raymond & Campbell also have the contract for 1,400 feet of high trestle across Des Moines River valley. It will consist of wooden cluster bent trestle, the most of it 75 ft. high and over. All of the work to be done by November 1, 1881. The same railway has nearly one mile of track laid and a construction train running.

Quite a notable engineering undertaking has just been completed in Russia, in the shape of a long bridge over the Volga, on the Syoran & Orenburg Railway, connecting the cities of Syora, in the government of Simbirsk, with that of Samara. The width of the river is nearly a mile, and, as it is liable to the occurrence of heavy spring floods, the piers—of which there are fourteen altogether—had to be built 100 feet above mean water level, the depth of the water being more than fifty feet. The great girders, 364 feet long and 20 feet wide, were all riveted and put together on the right bank of the river, and then floated to their position. The whole cost of the structure, which is regarded as a model of it kind, was 7,000,000 silver rubles.

The Toronto Bridge Company have secured the contract for building the bridges on the Canadian Pacific Railway. The work is to be constructed almost wholly of steel, and will be first-class in every respect. The company are now erecting two 200-ft. steel truss spars and four 50-ft. steel plate girders at Rat Portage, Manitoba, and are shipping three spans, of 60 to 100 ft., for the Pembina Branch of the C. P. Railway, and have now in progress at their works two 230-ft. steel swing bridges and four 50-ft. steel plate girders for the same railway. The company have also secured contracts for the bridges on the Canada Atlantic Railway, and have now seven spans, of 50 to 125 ft., in progress for that line. They have now in process of construction two extensive additions, 210×70 ft. and 150×50 ft., to their works in Toronto, and are making extensive additions to their machinery.

RAILROADS.

A railway is to be built up Mount Lafayette, of the White Mountain range. The mountain is 5,290 feet above the level of the sea, and its summit can be reached by a climbing line of three miles. Its estimated cost is $150,000.

Work on the New Orleans Pacific is progressing rapidly, in spite of the warm weather and scarcity of labor. When completed, it will be one of the most substantial roads in the country. The maximum grade is 0.8, and maximum curve 2°.

PETERBORO', Ont., June 27.—Mr. Campbell, of Port Perry, has commenced to purchase the right of way for the Toronto & Ottawa Railway between Peterboro' and Madoc, and where the line crosses the Brockville & Ottawa Railway. It is expected that work will be actively begun within a few days in constructing the line.

Work on the South Side Cable Railway, Chicago, is being pushed forward with great rapidity in the various departments of the company's shops, and at the Union Foundry, where the iron yokes, the heaviest part of the enterprise, are being prepared. When 300 of these, representing 1,200 feet of the road, are finished, work will be begun on State street.

W. H. Vanderbilt has given orders to the engineering departments of the Lake Shore & Michigan Southern and Michigan Central railways to reduce the grades wherever it shall be found practicable. He desires to make 40 instead of 25 cars the average for freight trains on those roads. All this is being done with a view of reducing the cost of transportation and enabling the companies to compete more evenly with the lake carriers.

The Belt railroad around Chicago was organized on the 29th ult., by Elijah Smith, of Boston, in conjunction with the principal officers of the Chicago & Northwestern, Michigan Central, Chicago, Burlington & Quincy and Illinois Central roads. The capital stock was fixed at $5,000,000, and the following were elected directors: H. D. Ledyard, A. L. Osborne, C. E. Perkins, T. J. Potter, Albert Keep, Marvin Henghitt, W. K. Ackerman, Joseph S. Tucker and Elijah Smith.

The Joseph H. Brown rolling mill at South Chicago has been sold to Rhodes, Bradley & Co., and other New York capitalists, for $2,000,000. The purchasers will make great improvements. In the sale are included 400 acres of land. The works referred to have been running since 1874, being located on the Calumet River, south of the village of South Chicago proper, and it is said the establishment, always very prosperous, now has orders ahead for a month.

The Flint & Pere Marquette Railroad is again having considerable trouble with the sink-hole about two miles south of Holly. At this point the road runs between two small lakes, separated by a piece of ground some 10 or 12 rods in width, and it is generally believed that they are connected at a certain depth below the surface. At any rate, the company has built two different bridges there, and the last time used piles nearly 100 feet in length, but it has of late been slowly giving way. They are now driving still longer piles and filling it with gravel, but it is doubtful if a more secure foundation is found.

A new railroad is being graded from Des Moines to Boone—distance, forty miles—called the St. Louis, Des Moines & Northern. This road will be completed and operated before next winter. It is but an arm and feeder of the great Wabash system of railways that has but recently entered Iowa at the capital, from whence it is stretching out its arms in every direction, bisecting and checkmating the great pooling trunk lines spanning the State from east to west, competing for the carrying trade.

The Milwaukee & St. Paul Railroad is being graded through the southern part of Boone County, while the Toledo branch of the Chicago & Northwestern is running its cars to Stratsford, on the Des Moines branch, sixteen miles north of Boone, and the St. Paul & Minneapolis Railroad is extending its line south from Fort Dodge through Ogden, eight miles west of Des Moines. There seems to be a great mania for building new railroads in Iowa, and it is safe to say that by the close of the year two thousand miles will be added to the five thousand now operated in the State.

RIVERS AND HARBORS.

Wilham Stanton, of Cohoes, has received the contract for removing the reef in the Hudson River at Van Wie's point below Albany, for the sum of $37,000. About 7,000 feet of rock and earth are to be removed.

Work at the Davis Island dam, in the Ohio River just below Pittsburgh, is progressing rapidly. The lock walls have been completed with the exception of the coping, and work was commenced a few days ago preparatory to driving piles for the coffer dam across the channel. This will close the channel temporarily.

For several days past surveyors have been at work along the river between Troy and Albany under the direction of the State Engineer and Surveyor, for the purpose of surveying the channel with the object of its being deepened. The work of dredging will be let in a few days.

NEW PROJECTS.

The Baltimore & Ohio road will, it is stated, furnish $1,000,000 to extend the Valley road of Virginia into the heart of the mineral region.

The New York & Connecticut Railroad Company has filed a petition with the Railroad Commissioners at Hartford for location of road between New York and New Haven. This is to be an independent line.

Five surveying parties are now engaged upon the extension of the Macon & Brunswick Railroad between Atlanta and Macon. The road will be 90 miles long—13 miles shorter than the link of the Georgia Central between Atlanta and Macon. Work is being pushed upon the road between Atlanta and Rome.

A. V. Peck, Chief Engineer of the Cincinnati, Wabash & Michigan Railroad Extension, left Elkhart, Ind., Monday last, with a force of surveyors, to locate a permanent line from the Michigan and Indiana state line to Benton Harbor. The building of the extension will be hurried forward. Bids are now being received on the grade work.

The charter for the Pittsburgh & New York Railroad has been granted at Harrisburg. This road extends from Bradford, Pa., to Parker City, making a connection between the Rochester & Pittsburgh and the Pittsburgh & Western roads. Wallston H. Brown is President of the road, and the capital stock is $4,000,000. Work will be commenced at once.

The Iowa Northwestern Railway Company, the head quarters of which being Algona, filed articles of incorporation with Secretary Hull yesterday. The object of the corporation is the construction and operation of a railroad across Iowa. Their capital is fixed at $5,000,000, and Peter Meyer, S. R. Williams and H. Durand are the incorporators.

A bill has been passed by the N. Y. Legislature allowing the Delaware & Hudson Canal Company to fill up the canal from Honesdale to Rondout, a distance of about 150 miles, and replace it by a railroad. The work will be begun immediately. This will add another division to the rapidly growing and prosperous railroad system owned by the Delaware & Hudson Canal Company.

The bill legalizing the contract between the Newfoundland government and the Railway Syndicate Company of New York has become a law, and incorporates an American company, with a section allowing aliens to hold lands on the same terms as British subjects. The company contracts to build a line of 400 miles from St. Johns to the copper mines of Hall's Bay, opening up a great grazing, timber, grain and mining region. It will cost $6,000,000 and be done in three years.